65-459
#65.047
4 pages
c 1 of 5

CONFIDENTIAL

25X1

[redacted]

4 June 1965

Please Reference:
A51-65-3277

Gentlemen:

We are pleased to provide the tenth in a series of Monthly Progress Reports covering the effort expended on subject contract during the period of May 2, 1965 to June 1, 1965.

Clean Room Installation

As previously reported, the major work for the installation of the clean room is complete. During this reporting period, efforts by the [redacted] 25X1
25X1 [redacted] to satisfy the two outstanding problems continued.

Quality Control inspection showed that major light leaks existed in all sections. The sub-contractor spent considerable time in the resealing of the ceiling panels and fittings with a non-drying sealant known as Ten-X as manufactured by the Electro-Cote Co. This operation proved unsuccessful due to the flexing of the ceilings under pressure loading. The only alternative solution to the problem was to give permission to seal the structural ceiling of the area surrounding the clean room. [redacted] Quality Control 25X1
is in the process of checking the results.

25X1 To date, the [redacted] has not been entirely successful in solving the main problem of holding temperature and humidity within the specified limits. The modifications described in report #9 were carried out and the rooms run under test for approximately one week. Although a noticeable improvement was effected, cycling of the control system is still apparent. Further adjustments have been proposed and will be carried out.

continued - - -

CONFIDENTIAL

A final acceptance test procedure was drawn up and given to the subcontractors. This test procedure will ensure that the recorded performance of each section of the clean room is within the tolerance specified in the exhibit of the contract.

With regard to the previous dates given for completion, and the difficulties being experienced by the subcontractors in meeting the specification requirements, no new completion date has been requested by us. Insistence is being placed on continuous efforts being required of the subcontractors to solve their problems in the shortest possible time.

Research Program

1. The following assignments were continued during this reporting period.

25X1

Assignment [redacted] - Hydromatic liquid bearing.
" - Evaluation of the effect of elevated processing temperatures on emulsions.
" - Design and testing of air bearings.
" - Liquid bearing incorporating a built-in pump.

2. Assignment [redacted] - Work on the tapered hydromatic bearing continued.

The end-feed, methyl methacrylate, tapered liquid bearing was carefully disassembled. Certain sections were then built up by a special epoxy formulation, so that design features indicated by previous testing could be incorporated. It is expected that the redesigned bearing can be tested and the results recorded before the end of this program. We hope to be able to pronounce certain mathematical relationships in the design parameters controlling bearing performance.

25X1 3. Assignment [redacted] The testing of film type, 5427 was temporarily stopped due to the great spread of results, indicating instability at higher processing temperatures. With the receipt of new type 4401 film stock, film test samples were exposed and processing at various temperatures conducted. Due to densitometer failure, no readings of the first batch of processed samples has yet been taken.

25X1 4. Assignment [redacted] Material for construction of a built-in blower type air bearing was placed in procurement.

continued - - -

25X1

5. Assignment [redacted] As stated in the February Interim Report, the Rotatron's film supporting cushion had proved to be quite unstable and introduced pulsations, or loping, in the film travel until the following modification was introduced. A perforated aluminum sheet was wrapped around the helix cage midway between the end supporting rings. When the cage was rotated counter clockwise and the motor rpm increased slightly, the supporting cushion became quite stable.

It is hoped to show the cause and location of the pulsations by the three-dimensional model of the pressure readings taken without the suppressing grid reported in the April Monthly letter. Since the grid, besides smoothing the supporting cushion, had the effect of changing the whole pressure distribution pattern, a new set of data was obtained with the grid in place and the rpm adjusted to 356. A minimum of 3 readings was taken at each of the 161 probe points and averaged. Reduction of data showed the pressure to be lowered by about 6 percent overall average. The complete data for the four dynamic conditions are being reduced to psi for inclusion in the final report on this assignment.

To estimate gallons per minute pumped by the Rotatron, a closely-fitting plastic cover was fabricated to fit over the rotor blades in place of the helical cage. A 1-1/2-inch tube was mounted on one side of this cover to act as a collector for the effluent. This tube was brought out through the side of the tank in such a manner that its center line co-incided with that of the Rotatron shaft. By measuring the steady-state input to maintain a constant pump head and the actual output delivered through the pipe, it is hoped to obtain a fairly accurate figure for the pumping capacity.

One interesting phenomenon was observed during the course of the foregoing measurements. The inclined manometer used in all the pressure measurements was filled with C.P. (carbon tetrachloride) specific gravity 1,585 at 25° C as an indicating fluid and the legs above the column with de-ionized water containing a blue dye. After some hours of running, a gelatinous precipitate formed at the interface of the water and carbon tetrachloride obscuring the meniscus. While carbon tetrachloride is slightly soluble in water (0.08 parts per 100 parts of water at 20°C), the resultant sol is not gelatinous. The possible effect of the dye was eliminated by repeating the experiment with clear water. Evidence pointed to a silica complex.

It was then ascertained that the anion and cation resin exchange beds (Amberlite type) used in the de-ionizer permit certain colloidal substances such as silica to pass through. Whether or not these adulterants have a deleterions effect on image quality could well form the subject of a fruitful research project.

continued - - -

25X1 Assignment [redacted] "To determine the coefficient of friction in Film" was written in rough draft form, the data assembled and correlated; illustrations prepared and the bibliography compiled. It was then decided to extend the usefulness of the report by illustrating the complete calculation of a hypothetical film processor starting from design specifications, through tank sizing and continuing to individual bearing loading.

In the process of rewriting the report to include this extension, some deficiencies in existent data came to light. One of these gaps turned out to be bend forces required about a "free" radius (encountered in typical air/liquid bearing applications) as contrasted to those required from film in being forced to conform to a roller-bearing radius. A short series of tests was performed which indicated that variations in bending force could be expected with changes in liquid temperature and whether the force was measured with or against film reel winding set. The wet versus dry film weight was also measured. When these could be performed while the processor was still technically on the drafting board.

All mathematical formulae, parameters such as viscosity, temperature, density and so on were reduced to simple charts and nomographs so that calculation could be completed with minimum effort or reference to other tables. It is felt that the data are basically sound because, when they were applied to the design requirements of the HTA-5 processor, they produced results within 2 percent of those obtained empirically after the machine was built. In the future, they should prove invaluable in avoiding costly design errors based on impossible criteria.

The funds committed or expended to date are approximately [redacted] exclusive of G & A. 25X1

If you should have any questions or desire further information, please do not hesitate to contact us.

Very truly yours,

[redacted] 25X1

MCM:ml

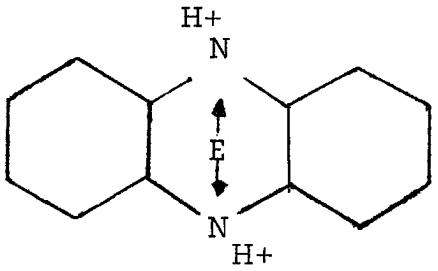
CONFIDENTIAL

ADDENDUM TO MONTHLY REPORT

This report, the second in a series of investigations extra-curricular to current assignments was conducted to evaluate the effects of oxidation of developer solutions, and to determine if a research program based on removal and inhibition of oxygen from such solutions could be justified. The investigation was commenced with a literature research, the results of which are summarized below.

As early as 1882, Berkeley introduced the use of sodium sulfite in organic developers as an oxidation inhibitor. Since that era, a monumental amount of research effort has been expended to determine the exact action of sulfites in photographic developer and the beneficial and/or deleterious effects on the additive on speed and gamma. A number of the basic findings on sulfite reactivity are presented after this summary. To these can be added some specialized esoteric research results.

For example, in developing systems of the hydroquinone-quinone type, the electrochemical potentials depend greatly upon the pH of the solutions. They may be considered as determined by the concentrations of the oxidized form and of the divalent ion of the reduced form. If K_1 and K_2 are considered the first and second dissociation constants of hydroquinone, it can be shown that hydroquinone in alkaline solution absorbs oxygen at a rate proportional to the square of the hydroxyl-ion concentration below PK_1. The reaction is auto-catalytic because of the formation of the highly reactive semiquinone. Semi-quinoids are radicals in which one electron is shared by 2 atoms which possesses a septet of electrons each (alternated to an octet by the odd electron) as:



Michaelis and Hill found them stable only in moderately acid solutions in their potentiometric studies of the radical.

James and Weissberger in their 1939 studies of the mutually oxidation inhibitory reactions of hydroquinone and sulfite stated that the action of sulfite on hydro-quinone is not known. They experimented with cysteine, thioglycolic acid, thioglycolic anilide, p-thioresol and barbital as antioxidants. These foregoing additives are all more difficult to obtain, more expensive or less effective and/or have more deleterious side effects than sodium sulfite.

In a classic study performed by Weissberger and Thomas in 1942, it was shown that silver catalyzes the decomposition of peroxide while the reaction of

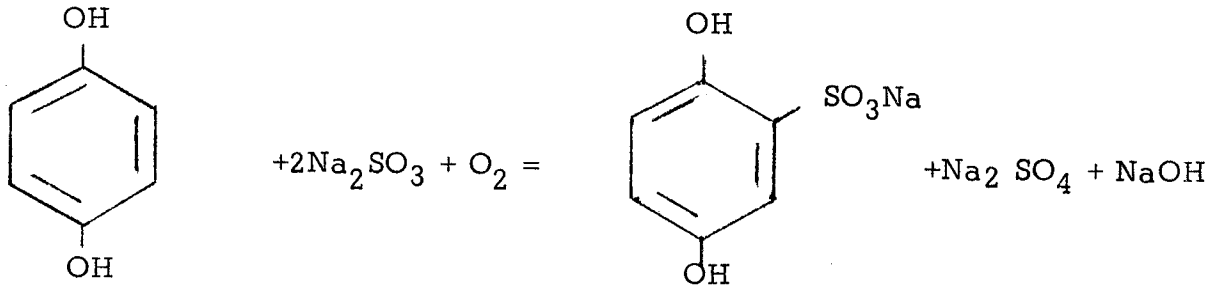
(more)

compounds produce significant staining. Although produced by the same reaction, these compounds are not mutually compatible, the perioxide attacks the quinone converting it into another compound, oxyquinone.

Oxyquinone is highly unstable and almost instantly passes over into a brown insoluble material. If this brown material is formed within a photographic emulsion, it cannot be washed out and remains there as a stain.

For the second stain-producing reaction, the presence of oxygen is not necessary. When hydroquinone acts as a developer, the silver bromide is converted into silver. Simultaneously, the hydroquinone is converted into quinone. This time no peroxide is formed. But, quinone is unstable in carbonate solution, although not so unstable as oxyquinone. The oxyquinone again passes into a brown insoluble material, producing a stain on the film.

When sulfite is present in the solution, the series of reactions are able to progress only to the quinone peroxide stage, because sulfite reacts very rapidly with both. With peroxide, it forms sodium sulfate, a soluble, relatively inert chemical. With quinone it forms a compound chemically known as sodium hydroquinone monosulfate. This is a colorless compound that is soluble and produces no stain.



The sulfite prevents stain because it is easily able to remove the two stain-forming materials, quinone and peroxide.

The stain-preventing action of the sulfite does not carry over to the removal of stain once formed. The stain is not produced by the quinone itself but by an oxidation and polymerization product of the quinone. Sulfite will not convert this material into a colorless product.

3. Acts as a silver halide solvent by the formation of complexes. Sulfite exerts a solvent action on silver chloride and silver bromide. The sulfite ion forms a number of soluble complexes of the form $Na_{(n+2)}\ Ag_n\ (S_2O_3)_{(n+1)}$ (when n= 1, 2, 3, 4 and, perhaps more) with the silver ions. This solvent action is of practical importance only with relatively dilute developer, or with developer of low alkalinity.

(more)

In fine grain developers, sulfite is used in a relatively high concentration. The solvent action takes place upon the surface of the silver halide grains preventing them from retaining their full size in development and reduces the tendency of the grains in close proximity to one another to merge and form larger clumps of silver.

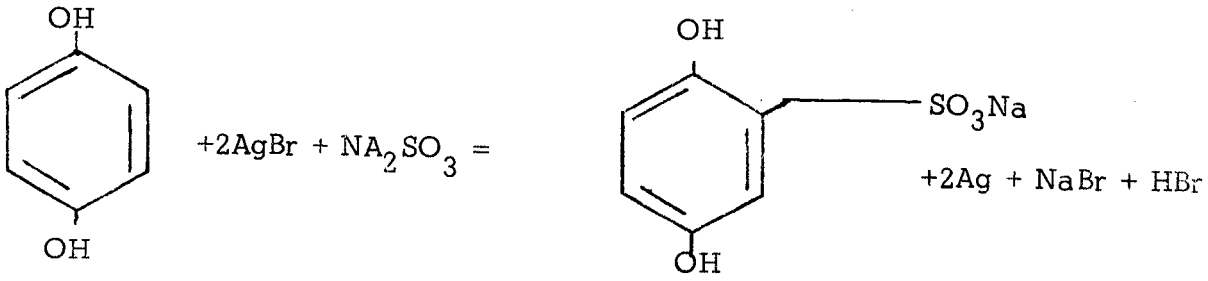
This action does not hold true in the use of all silver solvents. The use of a solvent can be overdone. Strong solvents produce an increase in graininess. The change in graininess produced by a solvent, also depends upon the emulsion in question. It is quite possible to obtain an increase in graininess with one emulsion and a decrease in another, the same addition of solvent to the developing solution being used.

4. Sodium sulfite is a weak alkali and under certain conditions, increases the rate of development and maximum density obtainable. Since sulfite raises the pH of the developer and accelerates the development in developers having a low pH, those having a high pH are affected slightly differently.

When added in large amounts to a developer composed of elon or hydroquinone, sulfite appears to retard development. A solution composed simply of hydroquinone carbonate and water will produce an image much faster than one containing sulfite. The reason for this is that sulfite, while it does not actually retard development, prevents the formation of oxyquinone, a material which otherwise would speed it up. What sulfite does do in this capacity is increase the maximum developer density obtainable for a given exposure. The cause of this increase is the dependence of the developer potential on the concentration of sulfite. As sulfite is added to the solution, the potential at first drops very rapidly and then more slowly. Since the density obtained for a given exposure varies almost linearly with the potential, it follows that the addition of small amounts of sulfite should increase the density greatly, as has been found to be the case.

5. Sodium sulfite also reduces excessive softening of the emulsion when high concentrations are used in a developing solution.

6. The reaction with silver bromide in the presence of sulfite follows the equation:



(more)

Acid is liberated in this reaction, which accordingly tends to decrease the pH of the solution. The reactions of metol in the presence of sulfite follow similar courses. On the other hand, 1-phenyl-3-pyrazolidone ("Phenidone") does not form a sulfonate. The sulfite is not as effective as a preservative for Phenidone as it is for metol and hydroquinone.

Conclusions

Based on the findings of the investigation it is our opinion that a research program to determine the most effective means of de-gassing solutions in processing machines, and in chem-mix and storage tanks where oxygen entrainment is at a maximum is justified.

6/4/65